

The Anatomy of *Equisetum diffusum* Tubers

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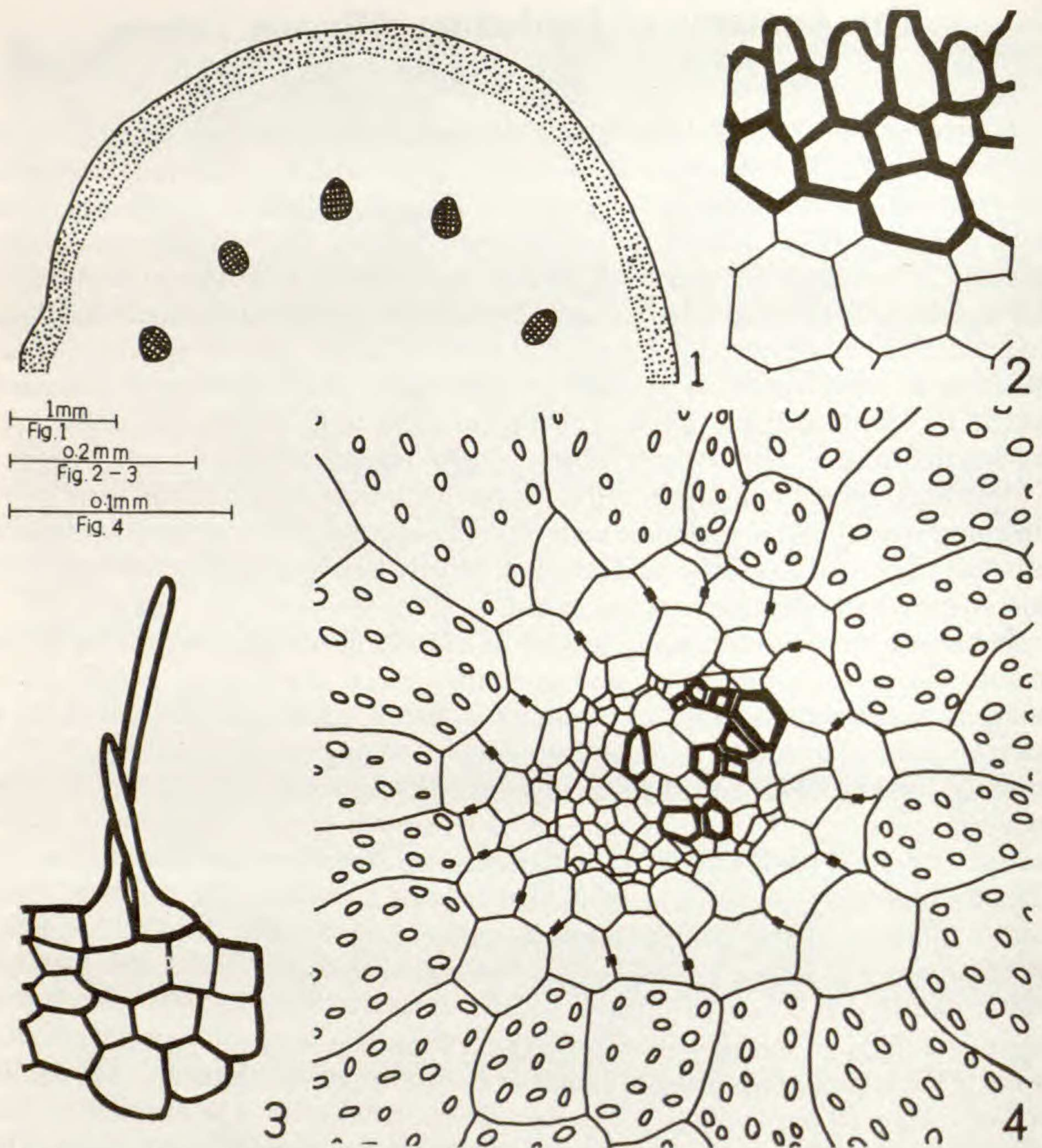
Equisetum diffusum D. Don, which belongs to subg. *Equisetum* (Hauke, 1974), is characterized by similar fertile and sterile stems, and is distributed throughout the Himalayas from Kashmir in the west to Darjeeling-Sikkim and Khasya in the east, at elevations of 1,500-2,400 m. It inhabits moist, partially exposed, sandy-gravelly soil along roadsides or in ravines, and is fertile from July to September. Up to four underground tubers may be present per plant during March and April on collections made from the Dhobi ghat and Pari Tibba, at 1,500 m elevation near Mussoorie, a hill resort in the western Himalayas. Such plants were described briefly by Mehra and Bir (1959). Tubers also occur in *E. arvense*, *E. palustre*, *E. sylvaticum*, and *E. telmateia* (Campbell, 1918; Hauke, in litt.).

Although the anatomy of *E. diffusum* has been studied by Sen and Sen (1973), the tuber structure has remained undescribed until now. Material from Mussoorie was fixed in formalin-acetic acid-alcohol. Mostly free-hand transections were cut and stained with safranin and fast green.

Tubers on the rhizome appear to arise as a result of stunted growth of the lateral shoots arising from the nodes, and generally consist of one long, swollen internode. A median transection of the tuber is almost circular in outline and has a narrow zone of tracheary tissue composed of a ring of 10-12 small collateral vascular bundles embedded in a large matrix of ground tissue (Fig. 1). The epidermis and 2 or 3 layers of outer cortex below it consist of somewhat thick-walled cells resembling cork. Usually these are devoid of any starch (Fig. 2). Often some long, papilliform epidermal hairs are present (Fig. 3). The inner cortex consists of thin-walled parenchymatous cells densely filled with simple, globular or oval starch grains having concentric striations and a well-marked, streak-like hilum. Each vascular bundle is demarcated by its own endodermal layer, the cells of which possess the usual casparian thickening on their radial walls. This is similar to the endodermis in *E. arvense* tubers (Barratt, 1920, fig. 9). A single-layered pericycle lies underneath the endodermis. The endodermis and pericycle have denser contents, compared with those of the adjacent tissue. The metaxylem elements are placed irregularly, with a few protoxylem elements somewhat mesarch in position. The carinal canal so characteristic of the rhizome and stem of this species is lacking in the tubers. Phloem has the usual structure (Fig. 4). Maceration of the xylem elements revealed only tracheids.

In contrast to the endodermis position in the tubers, that in the rhizome and stem of this species shows a common ring of endodermis surrounding all the vascular bundles. In my material, the root stele is di- or triarch, with two or three protoxylem groups surrounding a single axial metaxylem element, contrary to the earlier report of triarch roots by Sen and Sen (1973).

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FIGS. 1-4. Anatomical details of *Equisetum diffusum*. FIG. 1. Partial transection of tuber showing peripheral thick-walled cells and ring of vascular bundles. FIG. 2. Section of outer portion of tuber showing epidermis and cortex. FIG. 3. Long, papilliform hairs. FIG. 4. Vascular bundle and surrounding tissue of tuber.

LITERATURE CITED

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